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Creativity and Information Systems in a Hypercompetitive Environment: A Literature Review

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Abstract:

In today's hypercompetitive environment in which markets change rapidly and competitive advantages are difficult to sustain, companies are forced to innovate and identify new business opportunities. However, innovation requires ingenuity and creativity. Product and service development depends on the creativity of employees, but harvesting and bringing novel ideas to fruition is often a chaotic process, which underscores the importance of creativity management within organizations. In this article, we review the literature on creativity in an effort to summarize state-of-the-art knowledge on how to stimulate creativity and spur innovation in modern organizations. For that purpose, we use Rhodes' 4-Ps model (1961) distinguishing between creative environments (called press), people, products, and processes. Through a review of 110 journals on the AIS journal list, this article offers insights—based on eighty-eight articles—into how creativity can be stimulated and supported by attending to each of these components. The literature teaches us how to utilize, evaluate, and strategize about creativity in organizational settings. Managers are advised to advance creativity and ideation processes, for example by building virtual environments that strengthen collaboration and creativity across organizational boundaries. Researchers are encouraged to investigate the relationship between strategy and information systems (IS) usage in fostering creativity.

Keywords: creativity, information systems, creativity support systems, and innovation management

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I. INTRODUCTION

In a globalized business environment, the role of IT is changing and information systems become strategic assets driving business transactions, organizational processes, and knowledge sharing [Applegate, Austin, and Soule, 2009]. Therefore, companies increasingly use IT strategically in pursuit of business opportunities [Pearlson and Saunders, 2007]. Bill Gates described the changing role of IT over the last three decades in this way: "… if the 1980s were about quality and the 1990s were about reengineering, then the 2000s will be about velocity" [Attaran, 2004, p. 586]. In a similar vein, Pearlson and Saunders [2007] argue that the current business environment is characterized by hypercompetition, meaning that markets change rapidly and competitive advantages are short lived. Consequently, companies must innovate constantly in order to stay competitive. According to Tidd and Bessant [2009], "… innovation is consistently found to be the most important characteristic associated with success" [Tidd and Bessant, 2009, p. 9]. Innovation furthers business growth, enables companies to capture larger market shares, and is a means to increase overall profitability [Tidd and Bessant, 2009]. However, whether or not companies succeed in their innovation efforts largely depends on their creativity.

Creativity has attracted the attention of researchers and practitioners since the ancient Greeks. According to Couger [1996a], there are over 100 definitions of creativity in the literature—from the philosophy of Plato, to the mathematics of Poincaré, to the psychology of Freud. Creativity is often seen as complex constructions [Shalley, Gilson, and Blum, 2000] involving the production, conceptualization, or development of novel and useful ideas, processes, or procedures by an individual or group of collaborating individuals [Amabile, 1988]. Creative endeavors must be novel and have value that exceeds existing ideas [Couger, 1996a]. This makes creativity a critical factor in any innovation process by providing new ideas for product and service development [Govindarajan and Trimble, 2010], management of information systems, and training of IS personnel [Couger, 1996a]. However, creativity may also stifle innovation efforts in organizations if not properly managed, because massive flows of ideas potentially overwhelm decision makers [Levitt, 2002]. Creativity often gives managers a headache, due to its highly chaotic nature, defying traditional management practices. Creative people are notoriously difficult to manage, as they are intelligent, organizational savvy, and prone to ignoring corporate hierarchy by challenging decisions and questioning their surroundings [Florida and Goodnight, 2005; Goffee and Jones, 2007]. Yet innovative companies such as Google are able to harness the chaos and nurture novel ideas in a corporate culture of social creativity and a disregard of the possibility of failure [Iyer and Davenport, 2008]. Lego is another company that has reaped the benefits of including customers in the creative and collaborative development of their products, using online communities where users co-design new products through specialized software [Piller, Schubert, Koch, and Möslein, 2005]. In 2010 FLSmidth launched their "FLSmidth Idea Portal" to encourage everyone across the organization to participate in sharing innovative ideas and improving the company's product offerings. The portal receives 1500 daily visits and has generated more than 1000 novel ideas over the last two years.[1] Pixar fostered a strong creative culture through the use of technology, empowerment, and an open-minded community [Catmull, 2008]. Last, but not least, the "IBM 2010 Global CEO Study" of 1500 CEOs across thirty-three industries point to creativity as the most crucial factor for future success.[2]

Despite the importance of creativity in innovation in general and IS development in particular, no attempt has been made to establish an overview of our state-of-the-art knowledge of creativity within the IS field, with the exception of a minor review by J. Couger [1996c]. This article fills that knowledge gap. We have reviewed the IS literature on creativity by searching the 110 journals on the AIS list of MIS journal rankings[3]. Through an exhaustive and systematic search, we identified eighty-eight articles on the subject of creativity. These articles were then categorized based on a creativity framework for IS development [Couger, Higgins, and McIntyre, 1993] adapted from Rhodes' 4-Ps model of creativity [Rhodes, 1961]. Compared to the innovation literature, our literature review reveals a need for more research on creativity within the IS field.[4]

[1] See http://www.ipendo.com/Newsletter/Pages/FLSmidth-Profile.aspx.
[2] See http://www-03.ibm.com/press/us/en/pressrelease/31670.wss#contact.
[3] See http://ais.affiniscape.com/displaycommon.cfm?an=1&subarticlenbr=432.
[4] Topic searches in Web of Science yield more than ten times as many IS related references to innovation than creativity literature (4879 versus 443 hits).

A Definition of Creativity Management Within IS

Creativity is the creation of novel ideas by individuals or groups [Couger, 1996a]. Innovation is the adaptation and commercialization of these ideas [Smeltz and Cross, 1984; Levitt, 2002; Govindarajan and Trimble, 2010] in an organizational context [Amabile, 1996]. Innovation happens when ideas are plentiful and employees are motivated to do something about them [Govindarajan and Trimble, 2010]. This is a process of reusing ideas from existing innovations or combining new and existing ideas [Majchrzak, Cooper, and Neece, 2004]. However, researchers and practitioners have often merged creativity and innovation into one concept [Govindarajan and Trimble, 2010; Ginn, 1986]. This mix-up often occurs when researchers try to unfold the innovation process [Gorschek, Fricker, Palm, and Kunsman, 2010; Rigby, Gruver, and Allen, 2009] or describe the process of radical innovation [Malhotra, Majchrzak, Carman, and Lott, 2001]. This study concerns the development and management of ideas using IS or using these ideas for IS development purposes. Creativity in an IS context can manifest itself in the early stages of developing innovative information systems or services. During that process, creativity is managed by means of organizational strategies, best practices, skill enhancement, evaluation schemes, structures, and processes. Creativity is also about ideation supported by IS, for example, by creating virtual environments or by implementing other forms of computerized creativity support, such as brainstorming for the purpose of allowing employees and groups to explore new ideas together.

II. THEORETICAL FRAMING

Modern creativity research is rooted in the field of psychology where numerous studies have been conducted since the beginning of the early twentieth century [Couger et al., 1993]. The IS literature has adopted key concepts from the psychology and management literature in which there is a firm belief that individual and group creativity is motivated and enhanced through organizational incentives, such as work climate, training, and reward systems [Couger, 1996a; Couger et al., 1993]. In addition, various techniques and tools for skill enhancement can be used to foster greater creativity among individuals and groups in IS organizations [Cooper, 2000; Couger, 1996a].

Cooper [2000] identifies three research streams within creativity and IS development. The first stream involves techniques and software tools for skill enhancement [Rao and Dennis, 2000; Couger, 1996a]. The second focuses on strategies and conditions for implementing these techniques and tools within IS organizations [Kohashi and Kurokawa, 2005; Warr and O'Neill, 2005]. The third centers on Creativity Support Systems (CSSs) and IS supported creativity management, i.e., combining creativity management techniques with computer technology [Massetti, 1996; Shneiderman, 2002] However, in this article we identify a fourth stream with a focus on evaluation of creative activities, products, and services of IS organizations [Couger et al., 1993]. Our literature review is based on Rhodes' [1961] 4-Ps model and takes these research streams as a starting point.

The 4-Ps Model and IS

Couger et al. [1993] developed an IS-specific framework based on Rhodes' 4-Ps model of creativity [1961]. In the 4-Ps model, creativity is thematically divided into four highly interactive components: *Person*, *process*, *product*, and *press*.

The component of the creative *person* shows that some individuals are more creative than others [Rhodes, 1961] by genetic endowment [Guilford, 1977]. In an IS development context, the *person* component can be enhanced through the use of techniques and software tools for skill and creativity enhancement [Cooper, 2000]. In addition, management can stimulate creativity among employees through encouragement and by relying on proven techniques [Couger et al., 1993].

The component of the creative *process* deals with motivation, perception, learning, thinking, and communication. Creativity is seen as something than can be taught and learned [Rhodes, 1961]. Individuals can enhance their creative abilities by means of training programs and methods [Couger,et al., 1993]. In the IS literature, the *process* component takes center stage through the use of strategies and conditions for implementing skill-enhancing techniques and software tools within the IS organization [Cooper, 2000].

The component of the creative *product* is rooted in the evaluation and benchmarking literature. Products are artifact of thoughts that can be tested, evaluated, and analyzed in terms of creativity [Rhodes, 1961]. As Couger et al. [1993]) argue: *"… it is helpful for employees to have ways to measure their creativity results"* (p. 379). Prajogo and Sohal [2001] argue that management philosophies like Total Quality Management (TQM) ensure quality of current and future product and service innovations through an increased focus on customers, continuous improvement, and employee empowerment. However, TQM can also negatively impact the creation of novel solutions leading to unproductive "me too" competition when organizations focus on continuous, incremental customer-driven improvements rather than innovative solutions for new markets [Prajogo and Sohal, 2001]. Still, expectations of performance measurements or evaluations have a positive effect on creativity [Shalley, 1995]. From a management

perspective, creativity is about identifying, strategizing, and utilizing ideas from individuals and groups to accomplish organizational goals in new and originals ways [Couger et al., 1993; Shalley et al., 2000]. Thus, innovation is defined as the novel and useful application of a creative output (product or service) in an organizational setting [Couger et al., 1993; Oldham and Cummings, 1996; Shalley, 1991]. For the same reason, organizations evaluate or benchmark the quality of new creative products and services [Dean, Hender, Rodgers, and Santanen, 2006], for example, by examining the rarity [Eisenberger and Selbst, 1994] and originality [Redmond, Mumford, and Teach, 1993] of the idea or product.

The component of the creative *press* is about the work environment and its support for creativity in the organization [Rhodes, 1961]. The creative output of IS organizations is influenced by organizational values and norms that promote and chart a course for creative activities in the organization [Couger, Higgins, and McIntyre, 1993]. The creative environment can be supported by creativity-enhancing software that combines creativity management techniques with information technology [Cooper, 2000].

The 4-Ps Creativity Model

Couger [1996a] has used the 4-Ps creativity model in an early study of creativity [Couger, 1996c]. In this review, we extend the work of Couger by categorizing the IS literature based on the same model. The 4-Ps model is shown in Figure 1. For each "P", we provide a short description followed by an IS specific perspective on the component.

The creative press (environment)	The creative person
The creative environment in an organization affects individuals' and groups' creative output [Rhodes, 1961]. Organizational climate and culture enhances creativity by removing organizational barriers, rewarding ingenuity, and encouraging risk-taking behavior [Couger et al., 1993]. IS perspective IS supports the creativity of individuals and groups through a combination of creativity management techniques and computer technology [Cooper, 2000].	Some individuals tend to have more creative abilities than others [Rhodes, 1961] by genetic endowment [Guilford, 1977]. IS perspective Management nurtures employees' creativity through encouragement, by using well-proven tools and techniques [Couger et al., 1993], and by enhancing the IS development skills of individuals and groups [Cooper, 2000].
The creative product	**The creative process**
Products are the artifact of thoughts that can be tested, evaluated, and analyzed in terms of creativity [Rhodes, 1961]. The creative element of products and services can be evaluated and benchmarked in terms of novelty, relevance, performance, workability, and thoroughness [Dean et al., 2006], and the quality of current and future product and service innovations can be ensured through TQM and similar management philosophies [Prajogo and Sohal, 2001]. IS perspective When managing strategic goals in an IS organization, evaluation and measurement of creative IS product and service value is paramount [Couger et al., 1993].	The process perspective is based on the notion that creativity can be taught and learned, and it involves motivation, training, creative thinking, and communication [Rhodes, 1961]. IS perspective Creativity improvement programs and methods in IS organizations enhance overall creativity, quality, and productivity of employees [Couger et al., 1993]. This component focuses on strategies and conditions (requirements) for implementing skill-enhancing techniques and software tools within the IS organization [Cooper, 2000].

Figure 1. The 4-Ps Creativity Model

In the review methodology section, we describe our selection of keywords from the 4-Ps model for the purpose of analyzing and categorizing the literature.

III. REVIEW METHODOLOGY

Overall, our approach is based on Webster and Watson [2002] who offer guidance on how to carry out a literature review. From their perspective, synthesizing and reflecting on previous research provides a solid foundation for future advancements within the IS field [Webster and Watson, 2002]. According to Okoli and Schabram [2010], documenting choices is important when conducting a literature review in order to convince others of the reliability and quality of the result. We follow their advice by documenting our literature selection and analysis process. The details are provided below.

Searching the Literature

In terms of selection criteria, we focused on peer reviewed publications dealing with creativity within the IS field. To that end, we performed exhaustive searches in the 110 journals on the AIS list of journal rankings (see Appendix A), thereby excluding books and conference proceedings, with one notable exception. We decided to include papers from the premier creativity conference, the ACM Conference on Creativity and Cognition, because conference papers often contain more playful perspectives and provide a window into new trends and themes. Figure 2 gives an overview of the literature search and selection process.

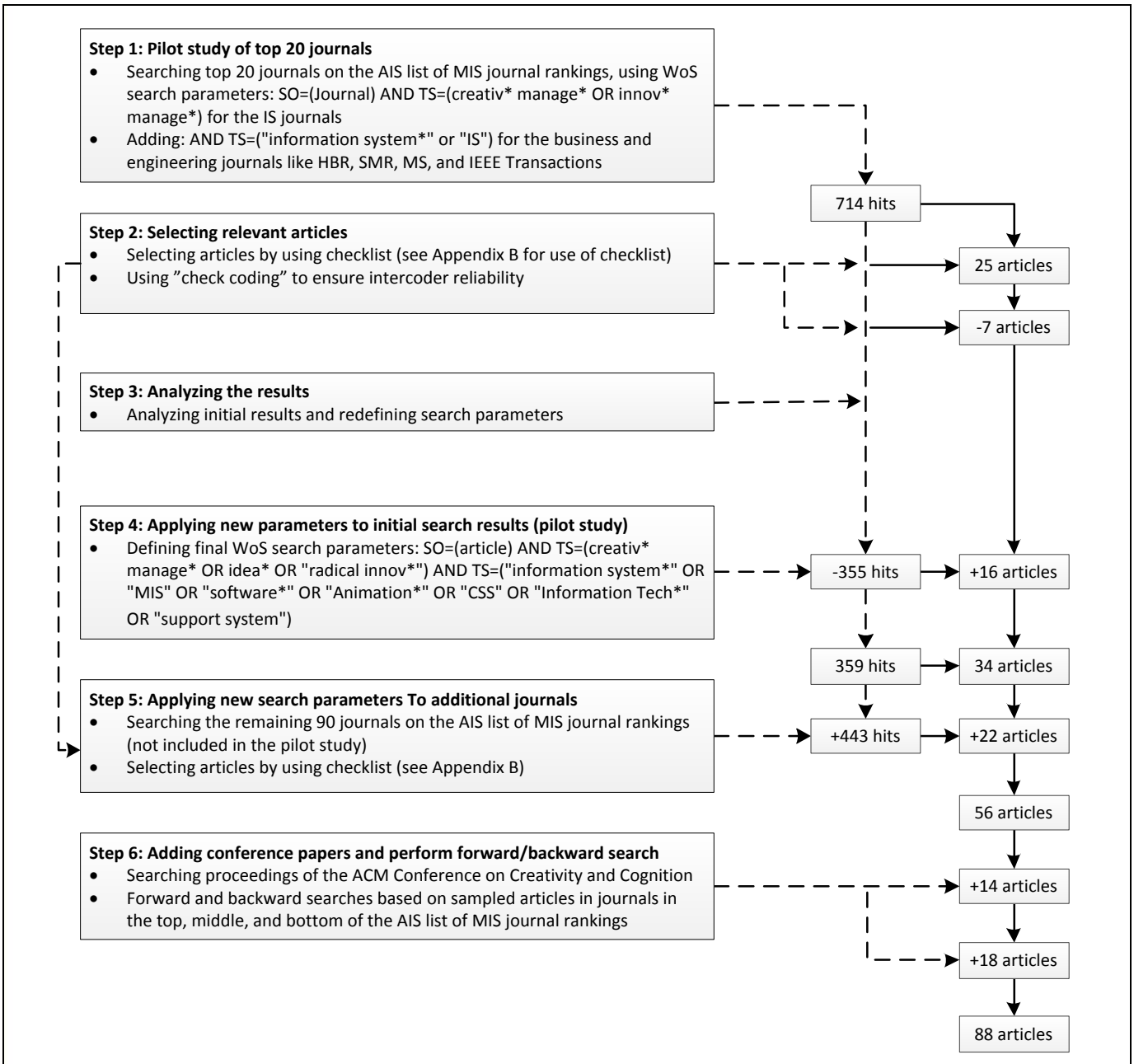

Figure 2. Literature Search and Selection Process

As illustrated by Figure 2, we first conducted a pilot study by searching the top twenty journals on the AIS list of MIS journal rankings. The purpose of this pilot study was to test the search parameters. This step (Step 1 in Figure 2) resulted in 714 articles.[5]

[5] We used the following databases and search engines: Web of Science, Proquest, Scopus, and Google Scholar. We used a combination of search facilities because not all journals are accessible through one database/search engine.

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Second, we reduced the initial pool of articles to twenty-five through manual selection. To that end, we used a three-step checklist for article screening [Okoli and Schabram, 2010] which encapsulates the research topic and contains predefined parameters for selection (see Appendix B). Subsequently, the relevance of each article was determined independently by each author and results were compared [Fink, 2009]. Through this process of "check coding," the number of articles was cut to eighteen. At this stage (Step 2 in Figure 2), the intercoder reliability was estimated at 80 percent—above the average 70 percent mentioned by Miles and Huberman [1994].

Third, we analyzed the results and redefined the search parameters in light of the pilot study (Step 3 in Figure 2).

Fourth, we applied the new search parameters to the same twenty journals used in the pilot study. This (Step 4 in Figure 2) resulted in a reduction in the number of potentially relevant articles from 714 to 359, out of which an additional sixteen relevant articles were identified.

Fifth, we searched the remaining ninety journals on the AIS list of MIS journal rankings that were not included in the pilot study (Step 5 in Figure 2), yielding 761 potentially relevant articles. Out of this pool of articles, we selected fifty-six, using the checklist for article screening (see Appendix B).

Sixth, we searched the proceedings of the ACM Conference on Creativity and Cognition and found fourteen papers. In addition, we conducted forward and backward searches based on sampled articles in journals in the top (ranked 1–5), middle (ranked 45–60), and bottom (ranked 100–110) of the AIS list of MIS journal rankings.[6] At the end of the literature search and selection process (Step 6 in Figure 2), we identified eighty-eight relevant articles across the 110 journals.

Analyzing the Literature

For the purpose of analyzing the articles, we first identified keywords and themes for each component of the 4-Ps creativity model. These keywords and themes encapsulate each of the four Ps of the model. For each component there are three groups of keywords and themes mirroring Couger's descriptions of the four Ps in the creativity model [Couger et al., 1993]. This grouping reduces complexity and increases transparency of the model. Some keywords appear under more than one component because they carry different meanings in different contexts. One example is the word *quality* which appears in both *product* and *press*. In the component of the creative *product*, the keyword relates to product and service quality as opposed to worker performance quality in *press*.

Second, we coded the articles in a three-stage qualitative process (see Appendix B). In stage one, we coded the articles in SPSS according to component (*press*, *product*, *person*, or *process*), using the keywords and themes (derived from the 4-Ps creativity model) listed in Table 1 as a guideline. In stage two, we coded the articles according to theme using Table 1 as a guideline while correcting any errors from stage one. The result is shown in Table 2 in which the eighty-eight articles are categorized by component and theme. In stage three, we synthesized the articles, using a bottom-up approach in which the abstract, theoretical framework and conclusion of each article provided deeper insight into the research field. This approach also corrected any errors made during stage two. The combined process allowed us to code the same literature three times, strengthening the reliability of the coding effort.

Third, we coded the articles according to their reference discipline depending on their scientific heritage. The IS field is multidisciplinary, by nature drawing on other research traditions [Oh, Choi, and Kim, 2005]. The IS field is traditionally divided into two major camps, one drawing on design science and the other on natural or behavioral science [Hevner, March, Park, and Ram, 2004; March and Smith, 1995]. Benbasat and Weber [1996] have elaborated on this argument by distinguishing among four major reference disciplines [Benbasat and Weber, 1996], specifically, organizational science [Cooper, 2000], economic science [Hunton and Beeler, 1997; Zhu, Kraemer, Gurbaxani, and Xu, 2006], behavioral science [Massetti, 1996], and computer science [Andreichicov and Andreichicova, 2001]. Several other researchers have contributed to this debate [Oh et al., 2005; Swanson and Ramiller, 1993; Vessey, Ramesh, and Glass, 2002]. We have identified the reference disciplines of all articles based on Oh et al.'s Taxonomy of IS Research [Oh et al., 2005]. This type of coding enables us to locate each article in the IS landscape, position the articles in relation to one another, and identify needs for additional research.

[6] Differences in the size of the intervals are attributable to our wanting an equal number of journals wherein creativity articles have been published.

Table 1: Keywords and Themes for Each Component of the 4-Ps Creativity Model			
Component	Group	Keyword	Theme
Press	1	Environment(s), climate(s), culture(s)	Factors that influence the environment in creative IS organizations Software-based environment for creativity support, e.g., Creativity Support Systems (CSSs) or Group Support Systems (GSSs)
	2	Barrier(s), reward(s), risk(s)	Breakdown of barriers in IS organizations Use of reward systems to stimulate creativity Risk-taking in creative IS organizations
	3	Enhance(ment), support	Enhancement of creative employees' skills through IS support or training
Product	1	Evaluation, benchmarking, measure(ment), goal(s), performance, novel(ty), relevant/relevance, workability, thoroughness	Evaluation, measurement, or benchmarking of novel and creative IS products and services Impact of evaluation on performance of creative employees and groups Evaluation, measurement, or benchmarking of creativity performance and goals in IS organizations
	2	Product(s), service(s)	Evaluation of creative designs for products and services in IS organizations
	3	Value(s), quality, assurance(s)	Quality of creative products and services Quality assurance of processes for developing creative products and services, e.g., through TQM or SPI
Person	1	Ability/abilities, endowment	Genetic endowment or creative employees' abilities
	2	Individual(s), person(s), employee(s), group(s)	Impact of individuals and groups on creativity in IS projects Recruitment or job profiles of creative employees in IS organizations Leadership of creative individuals and teams
	3	Technique(s), skill(s), tool(s), Encouragement(s)	Techniques and software tools for skill enhancement of creative employees and groups in IS organizations Encouragement of creative employees in IS organizations
Process	1	Strategy/strategies, program(s), diffusion, requirement(s)	Strategies for improvement of creativity in IS organizations Creativity improvement programs in IS organizations Strategies and conditions for implementing creativity improvement programs in IS organizations
	2	Software tool(s), technique(s)	Strategies and conditions for implementing creativity techniques and software tools in IS organizations Organizational diffusion and adoption of software tools for supporting creative employees
	3	Improve(ment), quality, training, motivation, learning, creative thinking, communicate/ communication	Improvement of the quality and productivity of creative employees' performance in IS organizations Training strategies for creative employees in IS organizations

IV. ANALYSIS RESULTS

Our literature search revealed eighty-eight articles published between 1998 and 2011 across 110 IS journals. Figure 3 shows the distribution of articles across the components of the 4-Ps creativity model, and Appendix C lists the articles by journal (ranking). The majority—47 percent (41)—of articles fall within the component of the creative *press*. This is due to the high number of articles on Creativity Support Systems (CSSs) and Group Support Systems (GSSs). In all, 27 percent (24) of the articles relate to the component of the creative *person,* whereas *process* and *product* account for 20 percent (18) and 6 percent (5) respectively.

The distribution of articles across reference disciplines also shows some interesting results. 43 percent (38) of the articles draw on organizational science, 41 percent (36) on behavioral science, 16 percent (14) on computer science, whereas no articles have a basis in economic science. Not only is the distribution lopsided, but there is an entire area ripe for research.

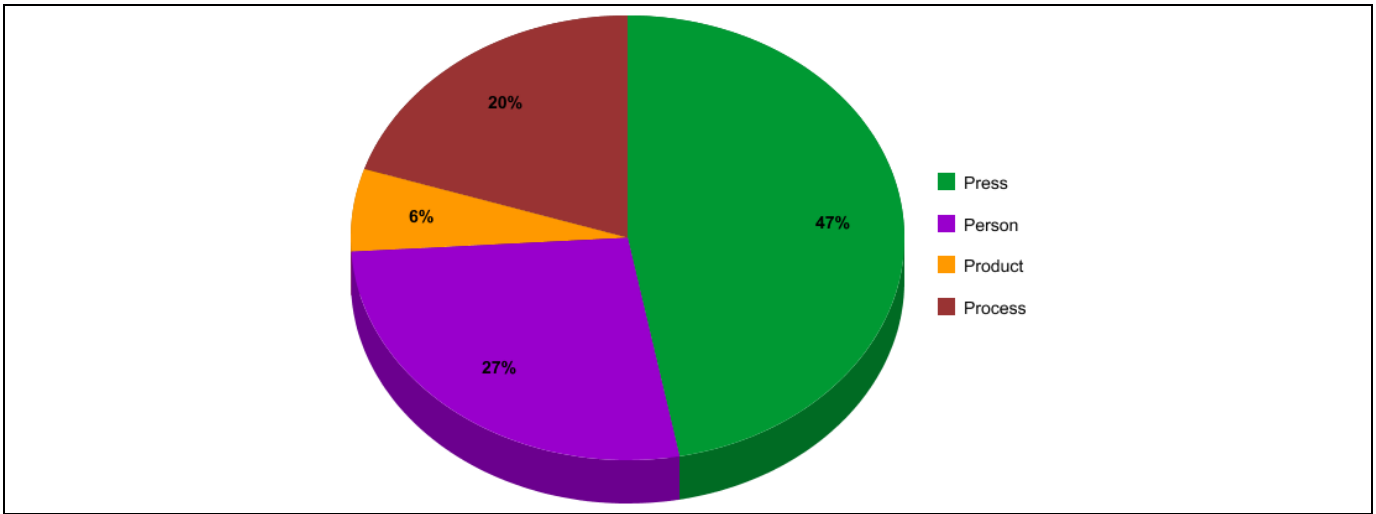

Figure 3. Distribution of Articles Across Components

Synthesis

We have identified key themes in the literature using a bottom-up approach. The result is shown in Table 2 in which references are sorted by component and underlying theme.

Press

The component of the creative *press* has been researched from various perspectives. Research on the use of Creativity Support Systems (CSSs), Group Support Systems (GSSs), and similar systems that provide virtual environments for creative personnel is dominant, judging by the number of publications (21). The research shows that information systems like CSSs and GSSs provide environments that lead to more novel and useful ideas compared to those fostered by paper-and-pencil approaches to ideation [Doll and Deng, 2011]. Creativity involves highly chaotic and complex processes which information systems render more manageable. Specifically, information systems help define problems and provoke opportunities, compile relevant information, generate new ideas or concepts, as well as evaluate and prioritize ideas for implementation [Abrams et al., 2002; Aiken and Carlisle, 1992; Hailpern et al., 2007; Hori, 1994; Kerne et al., 2008; Kletke et al., 2001; MacCrimmon and Wagner, 1994; Massetti, 1996; Nakakoji et al., 1999; Shneiderman, 2002; Doll and Deng, 2011]. GSSs give employees easy access to social groups and enhance communication between individuals and groups, which in turn provides a stimulating environment that allows them to share novel ideas and collaboratively explore their creativity [Elfvengren et al., 2009; Munemori and Nagasawa, 1991; Munemori and Nagasawa, 1996; Hesmer et al., 2011]. In contrast, other studies indicate that support systems do not always have a positive effect on creativity. Cheung, Chau, and Au's [2008] study shows how an intranet-based knowledge repository inhibits creative thinking among individuals and groups, because managers did not take employees' personal characteristics into account when implementing it. Other research points to the decline of creativity when support systems are used for analytical tasks [Durand and VanHuss, 1992]. AI-aided creativity has been among the research topics with regard to CSSs [Andreichicov and Andreichicova, 2001]. In relation to both CSSs and GSSs, such information systems have been shown to negate gender-based differences in groups with both males and females when developing novel and useful ideas.

Consequently, organizations using CSSs and GSSs in their creative endeavors will be able to get input from women and men alike [Klein and Dologite, 2000]. Moreover, when Executive Information Systems (EISs) are combined with information retrieval (e.g., browsing of data, searching for answers to specific problems, etc.) and decision support, they foster creativity in leaders [Vandenbosch and Huff, 1997; Wierenga and van Bruggen, 1998].

Another part of the research revolving around the component of the creative *press* focuses on factors that influence the creative environment in IS organizations. Elam and Mead [1987], Marakas and Elam [1997], Bonnardel [1999], and Kohler et al. [2011] identify design principles and guidelines for virtual co-creation systems as a form of creativity-based systems. Thatcher and Brown [2010] show that creativity is positively influenced by demographic differences, such as work experience and education, with regard to information access. Meanwhile, social differences, for example, in terms of race/ethnic background, nationality, sex, and age, can impact negatively on creativity. Fagan [2004] and Jacucci and Wagner [2007] classify factors that influence the creative style and work climate of individuals and teams in IT departments. These are closely related to the factors influencing communication in the creative work environment [Tuikka and Kuutti, 2000; Zaman et al., 2010], e.g., how social

Table 2: Themes in the IS Literature on Creativity			
		Theme	Reference
Component	Press	Factors that influence the environment in creative IS organizations	Bonnardel, 1999; Bruns, 2007; Elam and Mead, 1987; Fagan, 2004; Fischer, 1999; Jacucci and Wagner, 2007; Kohler, Fueller, Matzler, and Stieger, 2011; Marakas and Elam, 1997; Thatcher and Brown, 2010; Tuikka and Kuutti, 2000; Wakkary and Maestri, 2007; Zaman, Anandarajan, and Dai, 2010; Sosa, 2011
		Software-based environment for creativity support, e.g., Creativity Support Systems (CSSs) or Group Support Systems (GSSs)	Wierenga and van Bruggen, 1998; Vandenbosch and Huff, 1997; Shneiderman, 2002; Nakakoji, Yamamoto, and Ohira, 1999; Munemori and Nagasawa, 1996; Munemori and Nagasawa, 1991; Massetti, 1996; MacCrimmon and Wagner, 1994; Kletke, Mackay, Barr, and Jones, 2001; Klein and Dologite, 2000; Kerne, Koh, Smith, Webb, and Dworaczyk, 2008; Hori, 1994; Hailpern, Hinterbichler, Leppert, Cook, and Bailey, 2007; Elfvengren, Kortelainen, and Tuominen, 2009; Durand and VanHuss, 1992; Cheung, Chau, and Au, 2008; Andreichicov and Andreichicova, 2001; Aiken and Carlisle, 1992; Abrams, Bellofatto, Fuhrer, Oppenheim, Wright, Boulanger, et al., 2002; Hesmer, Hribernik, Baalsrud Hauge, and Thoben, 2011; Doll and Deng, 2011
		Breakdown of barriers in IS organizations	Leonardi, 2011; Fischer, 2005; Faniel and Majchrzak, 2007; Catmull, 2008
		Risk taking in creative IS organizations	Eaglestone, Lin, Nunes, and Annansingh, 2003
		Enhancement of creative employees' skills through IS support or training	Webster and Martocchio, 1992; TaxÉn, Druin, Fast, and Kjellin, 2001
	Product	Evaluation, measurement, or benchmarking of novel and creative IS products and services	Reinig, Briggs, and Nunamaker, 2007
		Impact of evaluation on performance of creative employees and groups	Connolly, Jessup, and Valacich, 1990
		Evaluation, measurement, or benchmarking of creativity performance and goals in IS organizations	Dean et al., 2006
		Evaluation of creative designs for products and services in IS organizations	Gomes et al., 2006; Chan, Ip, and Kwong, 2011
	Person	Impact of individuals and groups on creativity in IS projects	Tiwana and McLean, 2005; Gero, 2002
		Leadership of creative individuals and teams	Malhotra et al., 2001; Florida and Goodnight, 2005
		Techniques and software tools for skill enhancement of creative employees and groups in IS organizations	Yuan and Chen, 2008; Valacich, Dennis, and Connolly, 1994; Shaw, Arnason, and Belardo, 1993; Santanen, Briggs, and de Vreede, 2004; Resnick, 2007; Rao and Dennis, 2000; Olson, Olson, Storrøsten, and Carter, 1993; Noguchi, 1997; McLaren, Vuong, and Grant, 2007; Malaga, 2000; Kuutti, Iacucci, and Iacucci, 2002; Knoll and Horton, 2011; Hender, Dean, Rodgers, and Nunamaker, 2002; Garfield, Taylor, Dennis, and Satzinger, 2001; DeRosa, Smith, and Hantula, 2007; Coughlan and Johnson, 2008; Couger et al., 1991; Chen, 1998; Bond and Otterson, 1998; Aiken, Vanjani, and Paolillo, 1996
		Encouragement of creative employees in IS organizations	Leimeister, Huber, Bretschneider, and Krcmar, 2009
	Process	Strategies for improvement of creativity in IS organizations	Seidel, Müller-Wienbergen, and Rosemann, 2010; Nambisan, Agarwal, and Tanniru, 1999; Maiden, Gizikis, and Robertson, 2004; Lindič, Baloh, Ribière, and Desouza, 2011; Herbold, 2002; Cooper, 2000; Brown and Duguid, 2000; Bragge, Merisalo-Rantanen, and Hallikainen, 2005; Välikangas and Sevón, 2010
		Strategies and conditions for implementing creativity techniques and software tools in IS organizations	Warr and O'Neill, 2005; Terry and Mynatt, 2002; Kohashi and Kurokawa, 2005
		Organizational diffusion and adoption of software tools for supporting creative employees	Kappel and Rubenstein, 1999; Gallivan, 2003
		Improvement of the quality and productivity of creative employees' performance in IS organizations	Song and Adams, 1994; Briggs and Reinig, 2010
		Training strategies for creative employees in IS organizations	Couger, 1996b

differences, for example, in terms of race/ethnic background, nationality, sex, and age, can impact negatively on creativity. Fagan [2004] and Jacucci and Wagner [2007] classify factors that influence the creative style and work climate of individuals and teams in IT departments. These are closely related to the factors influencing communication in the creative work environment [Tuikka and Kuutti, 2000; Zaman et al., 2010], e.g., how social structures in the organization affect creative thinking [Sosa, 2011] and how social-technical factors in the environment influence stakeholders in creative development and ideation processes [Bruns, 2007; Fischer, 1999; Wakkary and Maestri, 2007].

It is important to break down cultural barriers when accessing cross-department knowledge for ideation [Faniel and Majchrzak, 2007], sharing new technology ideas [Leonardi, 2011], collaborating in cross-cultural environments, and working creatively across spatial, temporal, and technological boundaries [Fischer, 2005]. Empowering employees to solve problems by themselves has proven useful when it comes to breaking down organizational barriers in creative cultures [Catmull, 2008].

Risk-taking is a factor that impacts creativity management in IS organizations. Eaglestone, Lin, Nunes, and Annansingh [2003] argue that while risk management may have a positive effect on an IS project, the constraints that risk management imply can also inhibit creativity.

Yet another strand of research focuses on empowering creative employees through IS support and training in the creative environment. Individuals' human–computer interaction influence training, learning, and creative abilities, such as spontaneity, exploration, and motivation [Shaw et al., 1993]. TaxÉn et al.'s [2001] findings demonstrate the positive effect on creativity by using cooperative inquiry methods when collaborating with young school children in designing an advanced storytelling technology.

Product

The component of the creative *product* is fairly unexplored by researchers. Only 6 percent (5) of the articles are written with this perspective on creativity in mind. Research findings demonstrate the necessity of evaluating the creative output in order to raise the quality of ideas produced [Reinig et al., 2007]. Evaluation has a positive effect on the performance of creative employees and teams when used properly [Connolly et al., 1990].

Dean et al. [2006] have examined the literature on idea evaluation and argue that the creativity evaluation literature is based on novelty-centric and multi-attribute definitions. From the novelty-centric perspective, evaluation focuses on the rarity and originality of the idea, product, or service. The multi-attribute definition is—as the name suggests—concerned with several attributes, including novelty (the novelty-centric perspective). In addition, the relevance (Does it solve a problem?), the workability (Is it implementable?), and thoroughness (Is it worked out in detail?) of the idea, product, or service is of interest. The creative performance, goals, or results of the IS organization can be assessed based on these attributes [Dean et al., 2006].

Other IS researchers have focused on design evaluation of new products or services, e.g., evaluation of the usefulness and novelty of creative software designs [Gomes et al., 2006] and product screening by assessing idea success rate, idea performance, and customer lifetime value [Chan et al., 2011].

Person

Research on the component of the creative *product* explores how techniques and software tools foster and enhance individual or group creativity. Such techniques and software tools include groupware-based creativity techniques [Garfield et al., 2001], brainstorming techniques [Aiken et al., 1996; Couger, McIntyre, Higgins, and Snow, 1991; DeRosa et al., 2007; Santanen et al., 2004; Valacich et al., 1994], picture- and word-stimuli techniques [Couger et al., 1991; Malaga, 2000], imagination techniques [Couger et al., 1991; Resnick, 2007], concept mapping and critical-reflection methods [Couger et al., 1991; McLaren et al., 2007], concept-classification methods [Noguchi, 1997], environment-based techniques [Couger et al., 1991], and tools that provide memory aid, platforms for development, or help in sharing ideas [Coughlan and Johnson, 2008].

Research also focuses on the merging of these techniques and software tools with IS. Kuutti, Iacucci, and Iacucci [2002] study creativity enhancement in the design of mobile units, while other researchers explore different creativity-enhancement techniques incorporated into the design of information systems like CSSs and GSSs. This includes electronic brainstorming techniques [Hender et al., 2002; Olson et al., 1993; Rao and Dennis, 2000; Yuan and Chen, 2008] and management approaches to business intelligence [Bond and Otterson, 1998; Chen, 1998]. In addition, managers may stimulate creativity and ideation by supporting the underlying mechanisms of idea-generation techniques (e.g., analogical thinking, consequence thinking, and adaptive use of existing knowledge) through IS [Knoll and Horton, 2011].

In addition, individual and team creativity has been shown to influence the outcome of IS projects; individuals' expertise influences overall team creativity [Tiwana and McLean, 2005]. Social influence and acts by individuals and groups also have proven to affect project creativity and design outcomes [Gero, 2002]. Consequently, leadership by creative individuals and teams is required. The literature explores the challenges associated with the leadership of interorganizational and virtual creative teams [Malhotra et al., 2001] and the principles of managing creative employees [Florida and Goodnight, 2005]. It has been demonstrated that various encouragements can motivate creative employees in IS organizations by establishing incentives for people to contribute with ideas and allowing ideas to compete [Leimeister et al., 2009].

Process

Within the component of the creative *process,* researchers have investigated various strategic factors influencing the enhancement of individual and group creativity. Creative activities are often associated with managerial challenges and organizational uncertainty because of the high level of risk involved. Therefore, in IS organizations, strategies for improving creativity through the use of information technologies are often needed to conceptualize how creativity can go hand in hand with business processes [Seidel et al., 2010] or to deploy IS in support of ideation processes [Lindič et al., 2011]. Among these are strategies for gaining competitive advantages through the creation of internal knowledge rather than reliance on external knowledge for the development of new competitive information systems [Nambisan et al., 1999] and strategies for getting user feedback on development ideas [Bragge et al., 2005]. Strategies are also needed for encouraging and managing creative requirements in IS development [Cooper, 2000; Maiden et al., 2004]. Furthermore, strategies are required for integrating new knowledge in the organization without inhibiting creative processes [Brown and Duguid, 2000], which is accomplished by balancing creativity and discipline [Herbold, 2002]. Yet, sometimes strategies for detaching creative ideas are necessary, because ideas have a tendency to take hold of managers and organizations which, in turn, may impact decision-making processes and outcomes negatively [Välikangas and Sevón, 2010].

Research on strategies and requirements for the development of creative techniques and software tools in IS organizations underscores the importance of creativity management practices that are compatible with market needs and IS development activities [Kohashi and Kurokawa, 2005]. In addition, modern user interfaces do not always support users' creative practices. Therefore, design guidelines are needed for developing support systems for creative people [Terry and Mynatt, 2002] and for mitigating the social influences on design teams when developing creativity software [Warr and O'Neill, 2005].

Process also involves research on organizational diffusion and adoption of software tools by creative employees in IS organizations, demonstrating that managers must consider creative employees' attitudes toward technological innovations that alter existing work practices in the creative process [Gallivan, 2003]. Developers of information systems for creativity enhancement must themselves consider how design issues, such as problem structure, engineering knowledge, expert systems, ideation, and the social context of technologies affect the adaptation and use of systems [Kappel and Rubenstein, 1999].

In order to improve the productivity of creative employees in IS organizations, managers must envision the possibilities for new products and services and help employees align product-development efforts with organizational needs and business strategies [Song and Adams, 1994]. This is accomplished by improving the ideation quality of individuals' creativity, e.g., by examining the relationship between the number of good ideas and the number of ideas contributed [Briggs and Reinig, 2010] and by having training strategies for creative employees. Couger [1996a] argues that IS curricula should allow students to conceptualize and develop creative approaches to problem solving in systems development [Couger, 1996b].

V. DISCUSSION

The purpose of this review is to get an overview of state-of-the-art knowledge on creativity within the IS research field. Having searched the 110 journals on the AIS list of MIS journal rankings, as well as the ACM Conference on Creativity and Cognition, we identified eighty-eight articles on the topic published between 1988 and 2011. As argued below, our analyses suggest that the research field lacks maturity compared to the literature on innovation in IS. Thus, there are many unexplored areas of research that await exploration. We discuss the implications of our literature review for both researchers and practitioners below, and we provide advice that enables practitioners to better meet the challenges of today's hypercompetitive environment.

Implications

Our existing knowledge suggests important implications for both managers and researchers. This is evident in managing creative employees and groups as well as managing creative processes in different organizational settings, which, in turn, has implications for the design of creativity-enabling software.

Implications for Research

In terms of the 4-Ps creativity model, it is surprising that the main body of research, i.e., 47 percent (41), focuses on the component of the creative *press.* This is probably due to the long tradition within IS research of exploring the social aspects of information systems [Hedberg and Jönsson, 1978; Kiesler, Siegel and McGuire, 1984; Lamb and Kling, 2003].

Research on the creative environment (the component of the creative *press*) has focused on optimal work conditions for creative employees and groups through software support (see Table 2). Studies show the positive effect of CSSs and GSSs on creativity by providing employees and managers in IS organizations with creative environments for developing novel and useful ideas for future innovations. Additional research is needed to investigate exactly how CSSs and GSSs affect creativity in IS supported environments [Eaglestone et al., 2003; Fischer, 2005]. In addition, research indicates that reward systems may have a positive effect on the creative environment [Couger, 1996a]. However, we found no dedicated research on the subject matter.

This article demonstrates that previous research has placed great emphasis on utilizing the creative potential in employees and groups. This is evident by the majority of the literature being placed within four large groups within the components of the creative *press*, *person*, and *process* (see Table 2). Research within these groups have focused on understanding human interaction with creativity facilitating systems, virtual environments, software tools, techniques, and strategies from behavioral, organizational, and computer science perspectives (see Table 2).

It is surprising that 16 percent (14) of the articles draw on computer science which suggests a positive relationship between understanding creativity and transforming this knowledge into useable software designs that creative people may utilize during ideation processes. The future use of AI-aided creativity [Andreichicov and Andreichicova, 2001] especially offers great prospects and new possibilities for both researchers and practitioners in terms of exploring and utilizing the benefits of human–computer interaction for creative purposes. However, additional research within this area is needed.

Even more surprising is the lack of research grounded in economic science, which leaves the field wide open for researchers to explore. The literature review reveals several interesting research topics, including the design and evaluation of economic systems for creative use. For example, Vandenbosch and Huff's study of executives' creative use of decision support systems could be related to the financial sector focusing on bankers, investors, and other financial decision makers [Vandenbosch and Huff, 1997]. Research could also investigate how employees within the financial sector might be able to break down creative and organizational barriers by using creativity software in their work environment [Faniel and Majchrzak, 2007]. In fact, most of the literature categorized under *press*, *product*, and *process* should inspire researchers to explore how support tools, virtual environments, and IS strategies might enable creative thinking among managers and employees in the financial sector. Research should also include implementation studies of creativity software in financial institutions.

Avenues for future research also exist for researchers interested in the component of the creative *process*, for example, by investigating the creative capability maturity of IS organizations, similar to studies within the software process improvement field [Herbsleb, Zubrow, Goldenson, Hayes, and Paulk, 1997], where creativity research is also lacking [Müller, Mathiassen, and Balshøj, 2010]. Moreover, additional research on quality-assurance systems and evaluation methods in an IS context would be useful to organizations struggling in their creative endeavors.

Implications for Practice

Managers may strengthen the creative environment by providing actors with new information, tools, and computerized ideation processes [Kerne et al., 2008; Massetti, 1996; Shneiderman, 2002] and by creating virtual environments across sites in IS organizations, which eases communication and breaks down organizational barriers [Catmull, 2008; Faniel and Majchrzak, 2007; Leonardi, 2011]. However, there are design challenges with regard to unlocking creativity when creating these environments, including challenges associated with human–computer interaction [Durand and VanHuss, 1992], organizational risk-taking [Eaglestone et al., 2003], and implementation of creativity-enabling IS [Cheung, Chau, and Au, 2008]. Meanwhile, research indicates that despite these challenges, creative environments created by IS have a positive impact on the creative output.

Managers are well-advised to recognize the positive effects of GSSs, CSSs, and similar systems in terms of enhancing employees' creative capabilities [Massetti, 1996]. However, managers need to be aware of the mitigating effects of organizational structures and actions on creativity, such as social power distribution, risk taking, and organizational governance [Fischer, 1999; Sosa, 2011; Thatcher and Brown, 2010].

Innovation of existing work practices implies that radical changes are achievable, for example, through business process reengineering [Hammer, 1990]. Innovation, in turn, requires creativity [Kettinger, Teng, and Guha, 1997]. Therefore, managers need to monitor and evaluate the flow of alternative creative ideas to develop effective strategies and make quality decisions [MacCrimmon and Wagner, 1994]. The literature offers little guidance, however, on how to evaluate creative and novel ideas in IS organizations. Only 6 percent (5) of the articles relate to the component of the creative *product*. These articles describe how evaluation improves idea quality [Reinig et al., 2007] and worker performance [Connolly et al., 1990], and how multiple creativity evaluation methods can be used [Chan et al., 2011; Dean et al., 2006; Gomes et al., 2006]. IS managers face different strategic options when deciding how to enhance and assess the quality of ideas. They may encourage employees to think in product-development terms based on organizational needs and business strategies [Song and Adams, 1994], use evaluation schemes to assess the quality of ideas, or provide training in creative thinking [Couger, 1996b].

The importance of strategies becomes evident when managers attempt to incorporate creativity into the organization or improve business processes [Seidel et al., 2010]. Research shows that strategies positively affect the design, use, and adaptation of creativity-enhancing software when managers know the underlying mental models behind creativity [Terry and Mynatt, 2002]. In addition, the social context and employees' needs and attitudes have also been identified as important factors impacting the development and implementation of creativity software [Gallivan, 2003; Kappel and Rubenstein, 1999]. Such contributions provide managers with new insights into the organizational mechanics of creativity. However, they also emphasize the need for research on creativity improvement programs in IS organizations and more knowledge about the strategies and conditions for the diffusion of creativity techniques and software tools.

Limitations

Even though we adopted a rigorous approach, our study has limitations. First, we selected articles from journals on the AIS list of MIS journal rankings and the ACM Conference on Creativity and Cognition. We have not covered articles published in other journals and conferences or research reported in books. Our reason for primarily relying on the AIS list is that it is inclusive, based on eight other ranking lists of software engineering and IS journals [Hardgrave and Walstrom, 1997; Lowry, Romans, and Curtis, 2004; Mylonopoulos and Theoharakis, 2001; Peffers and Tang, 2003; Rainer and Miller, 2005; Walstrom, Hardgrave, and Wilson, 1995; Whitman, Hendrickson, and Townsend, 1999; Katerattanakul, Han, and Hong, 2003]. We further complemented the basis for selection by including proceedings of the ACM Conference on Creativity and Cognition, because it is one of the premier outlets for research on creativity within the IS field. Our focus on journals and conferences proceedings known for their quality publications (due to peer reviews and similar measures) strengthens the validity of the analyses. However, by excluding books, journals not on the AIS list, and numerous conferences, there is a risk of overlooking important contributions to our knowledge of creativity published in other media.

Another limitation is our use of Rhodes' 4-Ps model of creativity [1961]. We have used the 4-Ps model for categorizing the articles, but in reality most articles deal with more than one component of the model. In his small-scale review, Couger categorizes articles within multiple components [Couger, 1996c]. However, whereas Couger looked at only a handful of articles, our review includes eighty-eight articles, which makes the same approach unfeasible in our case. To reduce the level of complexity and maintain the readability of the article, we decided to categorize each article by its main focus only. Instead, we identified central themes across the four components.

VI. CONCLUSION

In a hypercompetitive environment, companies' competitiveness depends on their ability to innovate, which in turn requires creativity. Creativity involves multiple perspectives with regard to the organizational environment and structures, behavioral engagement of employees and groups, design paradigms in software development, and evaluation and benchmarking of IS products and services.

We have conducted a comprehensive review of the literature on creativity within the IS field by searching the 110 journals on the AIS list of MIS journal rankings and identifying eighty-eight relevant articles published between 1988 and 2011. We categorized these articles based on Rhodes' 4-Ps model of creativity [1961], distinguishing among the creative *press*, *person*, *product*, and *process* components. We have also looked at the underlying reference disciplines behind the articles.

The review provides an overview of the literature and offers insights into the field of creativity and IS by describing the potential for and use of creativity in IS organizations. For researchers, the results highlight avenues for future research, for example, by emphasizing the need for additional research within the component of the creative *product,* which accounts for only 6 percent (5) of the articles published. The review also reveals a lack of research from an economic science standpoint, which suggests that the research field is not yet mature. Furthermore,

avenues for future research also exist within the component of the creative *process*, e.g., the creative capability maturity of IS organizations and quality assurance of creative processes. Last, but not least, additional research into the relationship between strategy and information systems usage in fostering creativity is needed. For practitioners, our findings demonstrate that managers can utilize strategies, software tools, techniques, evaluation schemes, reward systems, organizational awareness, and information systems to advance the creative potential of employees and groups in their pursuit of innovation—being a prerequisite for survival in today's hypercompetitive environment. Managers may strengthen the creative environment through IS supported ideation [Kerne et al., 2008; Massetti, 1996; Shneiderman, 2002] and virtual environments [Catmull, 2008; Faniel and Majchrzak, 2007; Leonardi, 2011]. In particular, GSSs, CSSs, and similar systems support employees in their creative endeavors [Massetti, 1996], and AI allows practitioners to explore and utilize the benefits of human–computer interaction for creative purposes [Andreichicov and Andreichicova, 2001].

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Editor's Note: The following reference list contains hyperlinks to World Wide Web pages. Readers who have the ability to access the Web directly from their word processor or are reading the article on the Web can gain direct access to these linked references. Readers are warned, however, that:

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APPENDIX A: AIS LIST OF MIS JOURNAL RANKINGS

The table below shows the journals on the AIS list of MIS journal rankings by ranking.

Table A–1: The AIS List of MIS Journal Rankings by Ranking

Rank	Journal	Rank	Journal
1	*MIS Quarterly*	59	*Computer Decisions*
2	*Information Systems Research*	60	*Information Technology and Management*
3	*Communications of the ACM*	61	*Wirtschaftsinformatik*
4	*Management Science*	62	*Information and Organization* (formerly *Accounting, Management, and IT)*
5	*Journal of Management Information Systems*		
6	*Artificial Intelligence*	63	*ACM Special Interest Group Publications*
7	*Decision Sciences*	64	*Expert Systems with Applications*
8	*Harvard Business Review*	65	*Information Systems Management*
9	*IEEE Transactions*	66	*Interfaces (INFORMS)*
10	*AI Magazine*	67	*Omega*
11	*European Journal of Information Systems*	68	*International Journal of Human–Computer Studies*
12	*Decision Support Systems*	69	*Database*
13	*IEEE Software*	70	*Journal of Systems and Software*
14	*Information and Management*	71	*Data Management*
15	*ACM Transactions on Database Systems*	72	*International Journal of Man–Machine Studies*
16	*IEEE Transactions on Software Engineering*	73	*Journal of Information Systems* (accounting)
17	*ACM Transactions*	74	*Journal of Information Systems Management*
18	*Journal of Computer and System Sciences*	75	*Journal of Information Technology*
19	*Sloan Management Review*	76	*Journal of Operations Research*
20	*Communications of the Association for Information Systems*	77	*Journal of Organizational Computing and Electronic Commerce*
21	*IEEE Transactions on Systems, Man, and Cybernetics*	78	*Information Resources Management Journal*
		79	*Journal of Information Technology Case and Application Research*
22	*ACM Computing Surveys*		
23	*INFORMS Journal on Computing*	80	*Journal of Information Systems Education*
24	*Academy of Management Journal*	81	*Journal of Systems Management*
25	*International Journal of Electronic Commerce*	82	*Journal of the American Society for Information Science*
26	*Journal of the AIS*		
27	*IEEE Transactions on Computers*	83	*Organizational Behavior and Human Decision Processes*
28	*Information Systems Frontiers*		
29	*Journal of Management Systems*	84	*Electronic Markets*
30	*Organization Science*	85	*Australian Journal of Information Systems*

Table A–1: The AIS List of MIS Journal Rankings by Ranking – Continued			
31	*IEEE Computer*	86	*Journal of Organizational and End User Computing*
32	*Information Systems Journal*	87	*Computer Supported Cooperative Work*
33	*Administrative Science Quarterly*	88	*Journal of Information Science*
34	*Journal of Global Information Management*	89	*Datamation*
35	*DATABASE for Advances in Information Systems*	90	*INFOR*
		91	*International Journal of Information Management*
36	*Journal of Database Management*	92	*Journal of Information Technology Management*
37	*Information Systems*	93	*Behaviour and Information Technology*
38	*MISQ Discovery*	94	*Expert Systems Review*
39	*Academy of Management Review*	95	*Journal of Education for Management Information Systems*
40	*Journal of the ACM*		
41	*Computers and Operations Research*	96	*Computer Journal*
42	*Human–Computer Interaction*	97	*Information Processing and Management*
43	*California Management Review*	98	*Electronic Commerce Research and Application*
44	*Information Technology and People*	99	*International Journal of Technology Management*
45	*Journal of Strategic Information Systems*	100	*Journal of Information Systems* (education)
46	*Journal of Global Information Technology Management*	101	*Computers in Human Behavior*
		102	*European Journal of Operations Research*
47	*ACM Transactions on Information Systems*	103	*The Information Society*
48	*Informing Science*	104	*Communication Research*
49	*Journal of Information Management*	105	*Information Research*
50	*Operations Research*	106	*Journal of International Information Management*
51	*Journal of Computer Information Systems*	107	*E-Service Journal*
52	*Business Horizons*	108	*Information and Software Technology*
53	*IEEE Transactions on Knowledge and Data Engineering*	109	*Simulation*
		110	*Database Programming and Design*
54	*Journal of Database Administration*		
55	*IBM Systems Journal*		
56	*Infosystems*		
57	*Journal of Information Technology Theory and Application*		
58	*Knowledge Based Systems*		

APPENDIX B: CHECKLIST FOR ARTICLE SCREENING

1. Does the article concern information systems or information technology research?

IF	Action
Yes	Keep
No	Remove

2. Does the article concern creativity or innovation?

IF	Action
Innovation as creativity = Innovation defined as creativity, ideation, or the creative process leading to innovation, e.g., the creative process in IS product or service development.	Keep
Innovation as Innovation = Diffusion of innovation, use of innovations, implementation, product development after ideation or creative process, etc.	Remove

3. Is the article's primary focus on creativity?

IF	Action
Yes. Main emphasis is on creativity, ideation, or the creative process leading to innovation.	Keep
No. Main emphasis is not on creativity, but on another subject like knowledge management or the innovation process.	Remove

APPENDIX C: REVIEWED ARTICLES

The table below contains the articles reviewed in this article sorted by journal (ranking).

Table C–1: Articles Reviewed Sorted by Journal (Ranking)

Journal (Rank)	Reference	Title	Component
MIS Quarterly (1)	Webster and Martocchio, 1992	Microcomputer Playfulness: Development of a Measure with Workplace Implications	Press
	Couger, Higgins, and McIntyre, 1993	(Un)Structured Creativity in Information Systems Organizations	Framework
	Massetti, 1996	An Empirical Examination of the Value of Creativity Support Systems on Idea Generation	Press
	Vandenbosch and Huff, 1997	Searching and Scanning: How Executives Obtain Information from Executive Information Systems	Press
	Wierenga and van Bruggen, 1998	The Dependent Variable in Research into the Effects of Creativity Support Systems: Quality and Quantity of Ideas	Press
	Nambisan, Agarwal, and Tanniru, 1999	Organizational Mechanisms for Enhancing User Innovation in Information Technology	Process
	Cooper, 2000	Information Technology Development Creativity: A Case Study of Attempted Radical Change	Process
	Malhotra, Majchrzak, Carman, and Lott, 2001	Radical Innovation Without Collocation: A Case Study at Boeing–Rocketdyne	Person
	Kohler, Fueller, Matzler, and Stieger, 2011	Co-creation in Virtual Worlds: The Design of the User Experience	Press
Information Systems Research (2)	Garfield, Taylor, Dennis, and Satzinger, 2001	Research Report: Modifying Paradigms—Individual Differences, Creativity Techniques, and Exposure to Ideas in Group Idea Generation	Person
Communications of the ACM (3)	Shneiderman, 2002	Creativity Support Tools	Process
Management Science (4)	Connolly, Jessup, and Valacich, 1990	Effects of Anonymity and Evaluative Tone on Idea Generation	Product
	MacCrimmon and Wagner, 1994	Stimulating Ideas Through Creativity Software	Press
	Marakas and Elam, 1997	Creativity Enhancement in Problem Solving: Through Software or Process?	Press
Journal of Management Information Systems (5)	Hender, Dean, Rodgers, and Nunamaker, 2002	An Examination of the Impact of Stimuli Type and GSS Structure on Creativity: Brainstorming versus Non-brainstorming Techniques in a GSS Environment	Person
	Santanen, Briggs, and de Vreede, 2004	Causal Relationships in Creative Problem Solving: Comparing Facilitation Interventions for Ideation	Person
	Tiwana and McLean, 2005	Expertise Integration and Creativity in Information Systems Development	Person
	Reinig, Briggs, and Nunamaker, 2007	On the Measurement of Ideation Quality	Product
	Leimeister, Huber, Bretschneider and Krcmar, 2009	Leveraging Crowdsourcing: Activation-supporting Components for IT-Based Ideas Competition	Person
	Briggs and Reinig, 2010	Bounded Ideation Theory	Process
	Knoll and Horton, 2011	Changing the Perspective: Using a Cognitive Model to Improve thinkLets for Ideation	Person
Harvard Business Review (8)	Brown and Duguid, 2000	Balancing Act: How to Capture Knowledge Without Killing It	Process
	Herbold, 2002	Inside Microsoft. Balancing Creativity and Discipline	Process
	Florida and Goodnight, 2005	Managing for Creativity	Person
	Catmull, 2008	How Pixar Fosters Collective Creativity	Press

Table C–1: Articles Reviewed Sorted by Journal (Ranking) – Continued			
IEEE Transactions (9)	Kappel and Rubenstein, 1999	Creativity in Design: The Contribution of Information Technology	Process
	Bragge, Merisalo-Rantanen, and Hallikainen, 2005	Gathering Innovative End-user Feedback for Continuous Development of Information Systems: A Repeatable and Transferable e-Collaboration Process	Process
Decision Support Systems (12)	Malaga, 2000	The Effect of Stimulus Modes and Associative Distance in Individual Creativity Support Systems	Person
	Faniel and Majchrzak, 2007	Innovating by Accessing Knowledge Across Departments	Press
	Cheung, Chau, and Au, 2008	Does Knowledge Reuse Make a Creative Person More Creative?	Press
	Thatcher and Brown, 2010	Individual Creativity in Teams: The Importance of Communication Media Mix	Press
IEEE Software (13)	Maiden, Gizikis, and Robertson, 2004	Provoking Creativity: Imagine What Your Requirements Could Be Like	Process
Information and Management (14)	Elam and Mead, 1987	Designing for Creativity: Considerations for DSS Development	Press
	Aiken and Carlisle, 1992	An Automated Idea Consolidation Tool for Computer Supported Cooperative Work	Press
	Durand and VanHuss, 1992	Creativity Software and DSS: Cautionary Findings	Press
	Song and Adams, 1994	A Morphological Approach to Generating Information Technology Product Ideas	Process
	Aiken, Vanjani, and Paolillo, 1996	A Comparison of Two Electronic Idea Generation Techniques	Person
	Gallivan, 2003	The Influence of Software Developers' Creative Style on Their Attitudes to and Assimilation of a Software Process Innovation	Process
Communications of the Association for Information Systems (20)	McLaren, Vuong, and Grant, 2007	Do You Know What You Don't Know? Critical Reflection and Concept Mapping in an Information Systems Strategy Course	Person
	Seidel, Müller-Wienbergen, and Rosemann, 2010	Pockets of Creativity in Business Processes	Process
IEEE Transactions on Systems, Man, and Cybernetics (21)	Shaw, Arnason, and Belardo, 1993	The Effects of Computer Mediated Interactivity on Idea Generation: An Experimental Investigation	Press
	Hori, 1994	A System for Aiding Creative Concept Formation	Press
Journal of the Association for Information Systems (26)	Dean, Hender, Rodgers, and Santanen, 2006	Identifying Quality, Novel, and Creative Ideas: Constructs and Scales for Idea Evaluation	Product
Organization Science (30)	Leonardi, 2011	Innovation Blindness: Culture, Frames and Cross-boundary Problem Construction in the Development of New Technology Concepts	Press
	Sosa, 2011	Where Do Creative Interactions Come From? The Role of Tie Content and Social Networks	Press
Journal of Strategic Information Systems (45)	Välikangas and Sevón, 2010	Of Managers, Ideas and Jesters, and the Role of Information Technology	Process
ACM Transactions on Information Systems (47)	Olson, Olson, Storrøsten, and Carter, 1993]	Groupwork Close Up: A Comparison of the Group Design Process with and Without a Simple Group Editor	Person
	Kerne, Koh, Smith, Webb, and Dworaczyk, 2008	combinFormation: Mixed-initiative Composition of Image and Text Surrogates Promotes Information Discovery	Press

Table C–1: Articles Reviewed Sorted by Journal (Ranking) – Continued			
Journal of Computer Information Systems (51)	Couger, 1996b	Creativity: Important Addition to National Joint Undergraduate I.S. Curriculum	Process
	Fagan, 2004	The Influence of Creative Style and Climate on Software Development Team Creativity: An Exploratory Study	Press
IEEE Transactions on Knowledge and Data Engineering (53)	Yuan and Chen, 2008	Semantic Ideation Learning for Agent-based e-Brainstorming	Person
Knowledge Based Systems (58)	Noguchi, 1997	An Idea Generation Support System for Industrial Designers (Idea Sketch Processor)	Person
	Tuikka and Kuutti, 2000	Making New Design Ideas More Concrete	Press
	Gomes, Seco, Pereira, Paiva, Carreiro, Ferreira, and Bento., 2006	The Importance of Retrieval in Creative Design Analogies	Product
ACM Special Interest Group Publications (63)	Coughlan and Johnson, 2008	Idea Management in Creative Lives	Person
Expert Systems with Applications (64)	Chan, Ip, and Kwong, 2011	Closing the Loop Between Design and Market for New Product Idea Screening Decisions	Product
International Journal of Human–Computer Studies (68)	Kletke, Mackay, Barr, and Jones, 2001	Creativity in the Organization: The Role of Individual Creative Problem Solving and Computer Support	Press
Journal of Systems Management (81)	Couger, McIntyre, Higgins, and Snow, 1991	Using a Bottom-up Approach to Creativity Improvement in IS Development	Person
Organizational Behavior and Human Decision Processes (83)	Valacich, Dennis, and Connolly, 1994	Idea Generation in Computer-based Groups: A New Ending to an Old Story	Person
Journal of Organizational and End User Computing (86)	Doll and Deng, 2011	Antecedents of Improvisation in IT-enabled Engineering Work	Press
Journal of Information Science (88)	Eaglestone, Lin, Nunes, and Annansingh, 2003	Intention and Effect of IS Solutions: Does Risk Management Stifle Creativity?	Process
International Journal of Information Management (91)	Lindič, Baloh, Ribière, and Desouza, 2011	Deploying Information Technologies for Organizational Innovation: Lessons from Case Studies	Process
Journal of Information Technology Management (92)	Rao and Dennis, 2000	Equality of Reticence in Groups and Idea Generation: An Empirical Study	Person
Behaviour and Information Technology (93)	TaxÉn, Druin, Fast, and Kjellin, 2001	Kidstory: A Technology Design Partnership with Children	Press
International Journal of Technology Management (99)	Bond and Otterson, 1998	Creativity Enhancement Software: A Systemic Approach	Person
	Andreichicov and Andreichicova, 2001]	Software for Inventive Problem-solving	Press
	Kohashi and Kurokawa, 2005	New Product Development and Creativity Management in Japanese Video Gaming Software Firms	Process

Table C–1: Articles Reviewed Sorted by Journal (Ranking) – Continued			
International Journal of Technology Management (99)	Elfvengren, Kortelainen, and Tuominen, 2009	A GSS Process to Generate New Product Ideas and Business Concepts	Press
	Hesmer, Hribernik, Baalsrud Hauge, and Thoben, 2011	Supporting the Ideation Processes by a Collaborative Online-based Toolset	Press
Computers in Human Behavior (101)	Klein and Dologite, 2000	The Role of Computer Support Tools and Gender Composition in Innovative Information System Idea Generation by Small Groups	Press
	DeRosa, Smith, and Hantula, 2007	The Medium Matters: Mining the Long-Promised Merit of Group Interaction in Creative Idea Generation Tasks in a Meta-analysis of the Electronic Group Brainstorming Literature	Person
	Zaman, Anandarajan and Dai, 2010	Experiencing Flow with Instant Messaging and Its Facilitating Role on Creative Behaviors	Press
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